Treatment of Radiation-Induced Urethral Strictures

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KEYWORDS

• Urethroplasty • Prostate cancer • Radiation therapy

KEY POINTS

- Most radiation-induced urethral strictures occur in the bulbomembranous junction, and urinary incontinence may result as a consequence of treatment.
- Radiation therapy may compromise reconstruction due to poor tissue healing and radionecrosis.
- Excision and primary anastomosis is the preferred urethroplasty technique for radiation-induced urethral stricture.
- Principles of posterior urethroplasty for trauma may be applied to the treatment of radiation-induced urethral strictures.
- Chronic management with suprapubic tube is an option based on patient comorbidities and preference.

RADIATION THERAPY AND URETHRAL STRICTURES

Prostate cancer remains the most common cancer in men with more than 200,000 new cases anticipated each year.[1] Common management options for prostate cancer include surgery, in the form of radical prostatectomy, or radiation therapy with external beam radiation (EBR), brachytherapy (BT), or a combination of both therapies.[2] Jarosek and colleagues noted that most patients (about 70%) elect radiotherapy compared with about 30% choosing surgery.[3]

Urethral strictures have been reported to occur in 2% of patients undergoing EBR, 4% to 32% for BT therapy depending on the dose, and 11% of EBR-BT combination therapy.[4,5] Risk factors for the development of radiation-induced strictures include transurethral resection of the prostate before radiation, regardless of whether EBR or BT was used,[6] as well as age, non-white race, low income, and increased comorbidity status (BT use only).[7] Ionizing radiation leads to direct tissue damage in the form of DNA damage and indirect damage via free radical formation within cells—both resulting in cellular apoptosis and subsequent replacement of functional tissue with scar. An additional consequence of radiation therapy contributing to the development of urethral strictures is vascular damage in the form of obliterative endarteritis.[8]

Analysis of trends in treatment over the last decade suggests that radiation therapy continues to grow in popularity for the treatment of both

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clinically localized and locally advanced prostate cancer.[9,10] This rising utilization trend, along with the characteristic lag-time from radiation exposure to clinically significant urethral stricture of more than 6 years,[11] contributes to what is expected will be an increase in patients presenting with radiation-induced urethral strictures.

THE CHALLENGE OF TREATING RADIATION-INDUCED URETHRAL STRICTURES

Several factors complicate repair of radiation-induced urethral strictures:

- Most of these strictures are located in the bulbomembranous urethra, which is a challenging position for repair because of difficulty in access. This location also confers the danger of rendering the patient incontinent after the procedure if the sphincter is involved in or damaged during the stricture repair or by radiation fibrosis itself.
- The commonly encountered radionecrosis of the prostate (Fig. 1) further impedes performing urethral anastomosis because sutures tend to tear through the necrotic tissue unless they are completely removed.
- The poor vascularity of the radiated tissue also impedes the healing process after urethroplasty,[12] contributing to the high recurrence rate following urethral stricture treatment compared with posttraumatic repairs. Recurrence rates are reported as high as 30%[11,13] in radiation-induced strictures repair compared with about 16% recurrence rate of urethral strictures overall.

Accurate diagnosis of the nature of the stricture is strongly recommended. A combined examination with a retrograde urethrogram (RUG) and voiding cystourethrogram (VCUG) is ideal to delineate features such as the location, length, and severity of the stricture (Fig. 2). This examination subsequently allows the surgeon to plan the surgical approach—perineal versus abdominoperineal, with or without pubectomy. The authors believe that one critical concept in the treatment of radiation-induced urethral strictures is urethral rest,[14] allowing for the stricture to declare itself in the fullest extent. Cystoscopy at the time of suprapubic tube placement may be a useful addition to the diagnostic workup, specifically to gauge the amount of radionecrosis. Further imaging with computed tomography or MRI is rarely beneficial in further delineating the stricture, but may be useful in cases of assessing neighboring organs for abnormality or those with concomitant fistula. Sexual function including erectile and ejaculatory competence should be recorded before surgical management of urethral strictures and reassessed postoperatively. Baseline erectile function may be preserved in 50% of patients undergoing urethroplasty procedures after radiation therapy, whereas ejaculatory function has not been studied in this setting.[11]

SURGICAL MANAGEMENT APPROACHES

Endoscopic Management

Endoscopic management including dilation and direct visual internal urethrotomy (DVIU) of radiation-induced strictures as first-line treatment has been proposed,[15] but should be discouraged especially after repeat recurrences. The risk of recurrence is reportedly nearly 50% in patients who underwent BT,[7] but the true incidence of recurrence is likely much higher. In addition, repeated urethral dilations and DVIU attempts often cause further fibrosis of irradiated tissues along with treatment delays.

The UroLume Approach

Over the course of the last 40 years, the treatment armamentarium to these strictures has evolved.

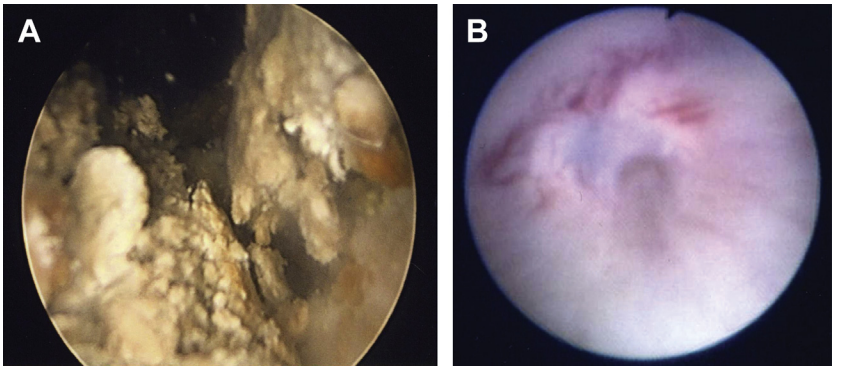

Fig. 1. Examples of cystoscopic images of radiation-induced urethral strictures. (*A*) Extensive radionecrosis of the prostate. (*B*) Complete urethral obliteration.

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